

Two New Species of Nudibranch Mollusks from the Gulf of the Farallones and Cordell Bank National Marine Sanctuaries, Central California

by

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Abstract. Two new species of nudibranchs are described from the central coast of California. *Armina cordellensis* is unique among described taxa in having low tubercles not arranged in distinct longitudinal rows. The radular teeth are elongate and minutely denticulate.

Aeolidia farallonensis is unique among described species in possessing a lateral anus and irregularly rugose rhinophores. The jaws are proportionately larger than in other described species. The anal position is situated ventral to the notum, a feature that is unique among described members of the Aeolidiidae.

INTRODUCTION

The opisthobranch fauna of the Pacific coast of North America has been recently reviewed (Behrens, 1991). More than 200 species have been reported from the region, including 26 undescribed species. Since then, several additional species have been recorded from deep waters off the coast of southern California (Gosliner, 1996).

Specimens of two apparently new species were examined from material held in the collections of the California Academy of Sciences. Neither species was observed alive. Both species differ markedly from sympatric congeners present in the eastern Pacific. Both species are known from relatively little material, but are sufficiently different from closely related taxa that there is little question of their distinctness.

This paper describes the anatomy of these species and compares them to morphologically similar species.

DESCRIPTIONS

ARMINIDAE

Armina Rafinesque, 1814

Armina cordellensis Gosliner & Behrens, sp. nov.

(Figures 1, 2)

Type material: Holotype, California Academy of Sciences, CASIZ 105717, Craine's Point, Cordell Bank, 20 km w of Point Reyes, 37°59'30"N, 123°24'30"W, 46-52 m depth, 20 October 1978, R. Schneider et al.

Etymology: This species is named for the type locality, Cordell Bank.

External morphology: The 60 mm long preserved animal is gray dorsally and on the ventral surface of the foot. Despite the fact that the animal had been preserved in

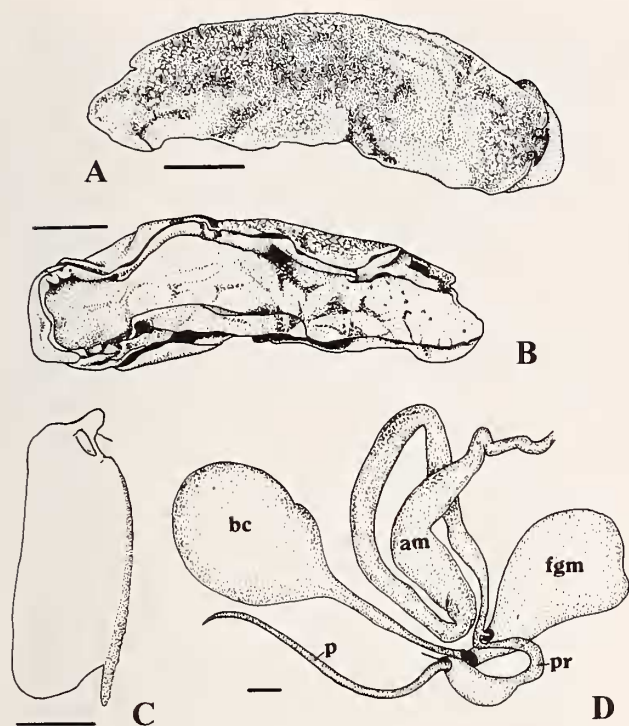


Figure 1

Armina cordellensis Gosliner & Behrens, sp. nov., holotype, CASIZ 105717. A. Dorsal view of preserved animal, scale = 10 mm. B. Ventral view of preserved animal, scale = 10 mm. C. Jaw, scale = 1.0 mm. D. Reproductive system, scale = 2.0 mm, am = ampulla, bc = bursa copulatrix, fgm = female gland mass, p = penis, pr = prostate.

alcohol, it appears that its color in life was also grayish, owing to the intensity of the pigment. The notum is granular with irregularly spaced, low rounded tubercles (Figure 1A). There do not appear to be any glandular sacs (cnidosacs) on the notum. The rhinophores are well separated from each other, about 2.5 mm apart, and have a series of longitudinal lamellae on the rounded, but not bulbous clavus. Between the ventral edge of the notum and the foot are a series of lamellar gills. Anteriorly, on each side of the body is a series of longitudinal lamellae. Immediately posterior to the right longitudinal lamellae are the genital apertures. Behind the apertures and extending to the posterior end of the body are 75–80 laterally arranged gill folds. The anus is situated on the right side of the body about three-fourths of the way to the posterior end of the body. The nephroproct is slightly more than halfway between the genital apertures and the anus. The foot (Figure 1B) is elongate and wide, and has a very thin epithelium.

Buccal mass: The buccal mass is elongate, 15 mm in length, and highly muscular. The salivary glands are elon-

gate and straplike and enter the posterior end of the buccal mass. The large chitinous jaws (Figure 1C) are elongate with a long masticatory margin. The masticatory border contains 6–10 rows of triangular denticles (Figure 2A). The radula of the holotype is asymmetrical and has a formula of $48 \times 42.1.69$. The rachidian teeth (Figure 2B) are broad with a large, triangular central cusp. The cusp is flanked by 8–13 elongate denticles per side. The inner lateral teeth (Figure 2B) are triangular with a relatively short cusp. Approximately seven to nine short, triangular denticles are present on the outer side of each inner lateral tooth. The next several teeth outward increase markedly in the length of the cusp and in the number of denticles. The majority of teeth are elongate and needlelike (Figure 2C). The outer edge of these teeth contains about 25 minute denticles, which are not visible under low magnification, but are evident at higher magnification (Figure 2D).

Reproductive system: The arrangement of the reproductive organs (Figure 1D) is androdiaulic. The ampulla is thick and contains several convolutions. It bifurcates and enters the base of the female gland mass. The other branch is the short, slightly curved prostate. It enters the slightly expanded penial sac. The penis, which is largely protruded, is elongate and flagellar. The large, saccate bursa copulatrix has an elongate duct, which exits adjacent to the female gonopore.

Discussion: Three species of arminids are currently recognized from the Pacific coast of North America. *Armina californica* (Cooper, 1863) can be readily separated from *A. cordellensis* by aspects of its external anatomy. The rhinophores of *A. californica* are adjacent to each other and have a common stalk, whereas those of *A. cordellensis* are well separated from each other. *Armina californica* has a series of longitudinal ridges on the notum, whereas *A. cordellensis* has irregularly arranged tubercles. Internally, the rachidian teeth of *A. californica* have fewer denticles (4–7) than those of *A. cordellensis* (8–13). The outer laterals of *A. californica* are not as elongate as those of *A. cordellensis* and have large denticles only near the outer apices rather than minute ones along most of the length of the teeth. The reproductive systems of the two species differ markedly as well. In *A. californica*, the prostate is elongate with several convolutions, whereas in *A. cordellensis* the prostate consists of a single short loop.

The other two arminids are found farther to the south in subtropical and tropical waters of Baja California and Panama. *Histiomena marginata* Mörch, 1859, is known only from the type material. Mörch described the external anatomy, and Bergh (1876) did not add any significant anatomical details. This species remains poorly known, and the description is so incomplete that it cannot be adequately compared to the present species. No type material or subsequent specimens have been found. *Histiomena convolvula* (Lance, 1962) has a series of convoluted, longitudinal ridges on the notum and a greatly expanded oral veil



Figure 2

Armina cordellensis Gosliner & Behrens, sp. nov., holotype, CASIZ 105717, Scanning electron micrographs. A. Jaw denticles, $\times 500$. B. Rachidian and inner lateral teeth, $\times 400$. C. Outer lateral teeth, $\times 200$. D. Outer lateral tooth, $\times 1500$.

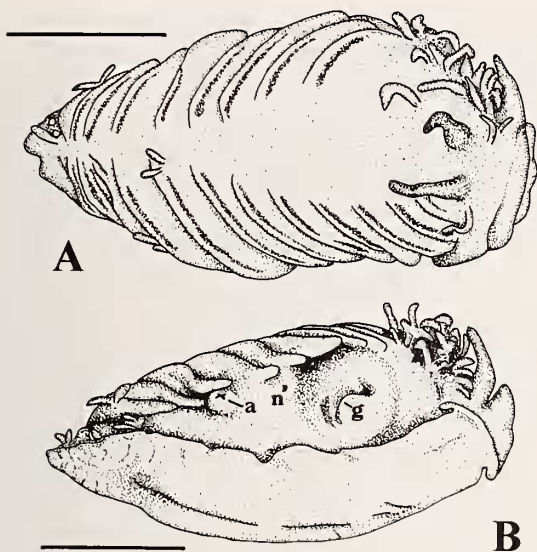


Figure 3

Aeolidia farallonensis Gosliner & Behrens, sp. nov. A. Dorsal view of preserved holotype, CASIZ 105718, scale = 10 mm. B. Lateral view of holotype, scale = 10 mm.

with an expanded margin. The posterior gills of *H. convolvula* are small fan-shaped structures arranged in four to five irregular rows (Lance, 1962), rather than the uninterrupted rows of simple lateral lamellae found in *A. cordellensis*. The rachidian radular teeth of *H. convolvula* are rectangular and lack the large triangular cusp found in *A. cordellensis*. There are more lateral teeth per half-row (88) in *H. convolvula* than in *A. cordellensis* (a maximum of 69 teeth per half-row).

Armina cordellensis is most similar to several species placed in *Linguella* Blainville, 1823, considered as a subgenus or synonym of *Armina* by modern workers. Species in this taxon have widely separated rhinophores without distinct tubercles between the anterior end of the notum and the rhinophores. The six described species, *A. fallax* (Bergh, 1880), *A. iaira* (Bergh, 1865), *A. punctilucens* (Bergh, 1874), *A. quadrilateralis* (Bergh, 1860), *A. sarasinica* (Bergh, 1890), and *A. variolosa* (Bergh, 1904), are all known from the Indo-Pacific tropics. Most of these species are known only from their original description and are incompletely described. *Armina sarasinica* differs from *A. cordellensis* in having fewer, more elongate denticles on the rachidian teeth (Bergh, 1890). *Armina variolosa* is uniformly reddish and has tubercles arranged in distinct longitudinal rows (Baba, 1955), whereas *A. cordellensis* is probably gray in life and has scattered tubercles. Also, in *A. variolosa* the genital apertures are anterior to the longitudinal gill lamellae whereas in *A. cordellensis* they are posteriorly situated. *A. variolosa* also has fewer lateral teeth (22–26) than *A. cordellensis* (42–69).

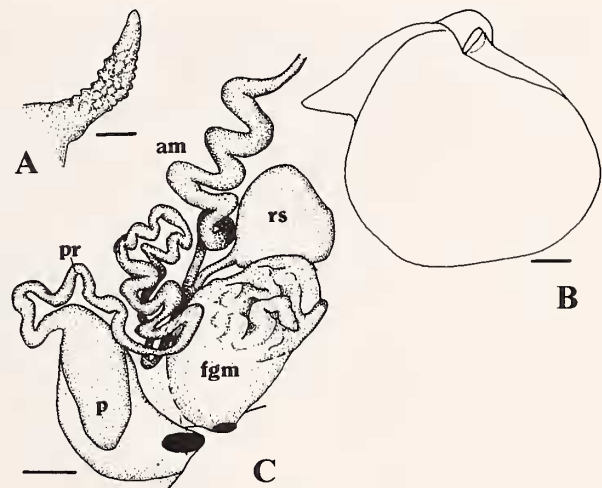


Figure 4

Aeolidia farallonensis Gosliner & Behrens, sp. nov. A. Rhinophore, scale = 1.0 mm. B. Jaw, scale = 1.0 mm. C. Reproductive system of paratype, CASIZ 105719, scale = 2.0 mm, am = ampulla, fgm = female gland mass, p = penis, pr = prostate, rs = receptaculum seminis.

AEOLIDIIDAE

Aeolidia Cuvier, 1798*Aeolidia farallonensis* Gosliner & Behrens, sp. nov.

(Figures 3–5)

Type material: Holotype, California Academy of Sciences, CASIZ 105718, off Farallones Islands, Gulf of Farallones, 37°27.9'N, 123°02'W, trawled from 510 m depth, 13 December 1985, Robert Van Syoc. Paratype, dissected, California Academy of Sciences, CASIZ 105719, off Farallones Islands, 37°35.3'N, 123°14.5'W, trawled between 1405–1491 m depth, 13 December 1985, Robert Van Syoc.

Etymology: This species is named for the Farallones Islands, from which the type material was collected.

External morphology: Both the holotype (Figure 3A, B) and paratype are largely devoid of cerata. Only a few scattered cerata remain attached to the notum. The preserved specimens are approximately 25 mm in length. The rhinophores (Figure 4A) are rugose with fine papillations scattered along their length. The oral tentacles are elongate and evenly tapered. The cerata are arranged on diagonal ridges. There are 13 ridges per side in both specimens examined. The anteriormost row contains 12 cerata while the seventh row has 38 cerata, based on the number of attachment bases that are still visible. The cerata appear to be dorsoventrally flattened in the few remaining cerata, but only small cerata are present. The anus, nephroproct, and genital aperture are visible on the right side of the body (Figure 3B). The genital aperture is situated ventral to the fourth to sixth ceratal rows in the paratype and

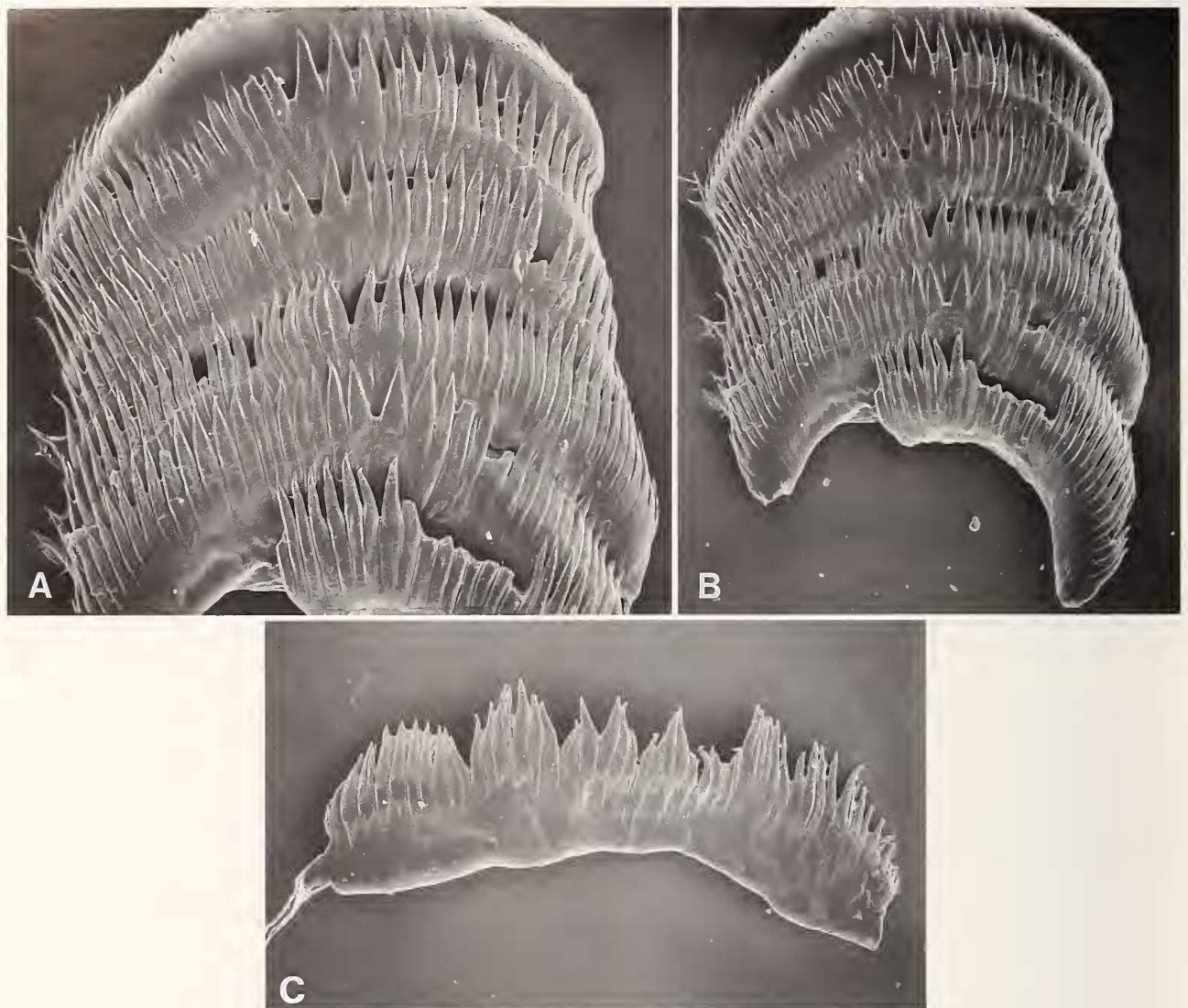


Figure 5

Aeolidia farallonensis Gosliner & Behrens, sp. nov. Scanning electron micrographs of radular teeth of paratype, CASIZ 105719. A. $\times 110$ B. $\times 80$. C. $\times 120$.

between the fifth to seventh rows in the holotype. The nephroproct is found at the base of the seventh or eighth ceratal row. The anus is pleuroproct, situated ventral to the ceratal rows. In the holotype it is found below the ninth and tenth ceratal rows, while it is found ventral to the eighth and ninth ceratal rows in the paratype. The anterior end of the foot is thickened, and short angular foot corners are present (Figure 3B).

Buccal mass: The buccal mass is thick and muscular. The jaws are thick and massive. The jaws of the paratype (Figure 4B) are 9 mm long and 9 mm wide. The masticatory border is elongate and completely devoid of any

denticles. The radula of the paratype is uniseriate and contains 30 teeth. The teeth (Figure 5) are pectinate with 38–53 shallow, triangular denticles. There is no median denticle. The two innermost denticles are widest and divergent, forming a “v” between them. The denticles vary in height and curvature.

Reproductive system: The reproductive system (Figure 4C) is androdiaulic. The ampulla is thin and highly convoluted. It bifurcates to the female gland mass and the elongate and extremely convoluted vas deferens. The large, saccate receptaculum seminis has a moderately long duct which joins the ampulla immediately prior to the bifur-

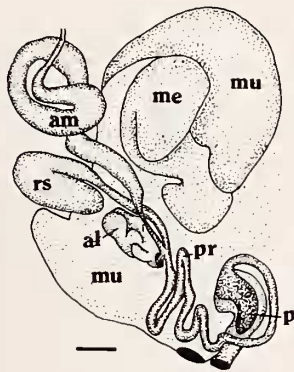


Figure 6

Aeolidia papillosa (Linnaeus, 1761). Reproductive system of specimen from Channel Islands, California, CASIZ 064212, scale = 1.0 mm, al = albumen gland, am = ampulla, me = membrane gland, mu = mucous gland, p = penis, pr = prostate, rs = receptaculum seminis.

cation of the female gland mass and vas deferens. The penial bulb is large and is occupied largely by the large, muscular, bulbous penial papillae, which are devoid of any armature.

Discussion: The systematics of the genus *Aeolidia* remains the subject of some confusion. Presently, only a single species, *A. papillosa* (Linnaeus, 1761), is recognized (Marcus, 1959, 1961), though populations are widely separated in the North Atlantic, North Pacific, and the subspecies, *A. papillosa serotina* Bergh, 1873, in the southern Atlantic and Pacific of South America. The present material of *A. farallonensis* differs from all described material of *A. papillosa* and from North Atlantic (New Hampshire and Maine) and North Pacific material (central and southern California) of *A. papillosa* examined in this study. The present material of *A. farallonensis* has rugose to papillate rhinophores, whereas the rhinophores of all specimens of *A. papillosa* are entirely smooth. The foot corners of *A. farallonensis* appear to be more highly developed than in *A. papillosa*. Specimens of *A. papillosa* have more ceratal rows (17) than specimens of *A. farallonensis* of a comparable size (13). The most obvious difference between the two species is the position of the anus. In all specimens of *A. papillosa*, the anus is cleioproctic (high up on the body), situated well within the space between the ceratal rows, whereas in *A. farallonensis* the anus is situated below the most ventral cerata in the pleuroproctic position. A pleuroproctic anus is considered plesiomorphic for aeolidaceans (Gosliner & Kuzirian, 1990). There appear to be more cerata per row in specimens of *A. farallonensis*. In *A. farallonensis*, there were up to 38 cerata per row, whereas in specimens of *A. papillosa* there were a maximum of 19–25 cerata per row.

Internally, the jaws of *Aeolidia farallonensis* are almost twice as long and more than twice the width of those of a

specimen of *A. papillosa* of the same size. The radular teeth are similar in the two species in number of teeth and denticles. The shape of the teeth seems more highly arched with more evenly graded, parallel denticles in specimens of *A. papillosa*. In *A. papillosa*, there is usually a small median denticle, whereas in *A. farallonensis* the two adjacent denticles at the median are strongly divergent rather than parallel.

The reproductive system of the two species is similar. It has not been depicted in most previous descriptions of *A. papillosa*, except by Odhner (1939) and is shown here in Figure 6. The vas deferens of *A. farallonensis* is much longer and more highly convoluted than that of *A. papillosa*, and the penial papilla is proportionately larger in *A. farallonensis*.

Although some questions remain as to the systematic status of specimens presently united as *A. papillosa*, all material is clearly distinct from *A. farallonensis*.

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